The Lewisian Pattern of Modern Growth & Convergence: Towards a World Without Farmers (1960-2050)?

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Yes, we can !?
The future we want !?

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Introduction

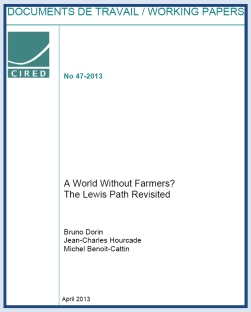
- Ecology *vs.* Poverty ?

There is an apparent disagreement between:

⇨ the "ecological critique" …that accuses "modern agriculture" of jeopardizing many ecological services through monocultures and the overuse of freshwater, fossil energy and other industrial inputs such as chemical fertilizers and pesticides [MEA, 2005; etc.]

⇨ the "techno-productivist approach" …that led economists to recommend, after the 2007-08 food crisis, to "revitalize agricultural R&D investments" [Alston et al., 2009] so that "modern agriculture" plays "its role as an engine of growth" [FAO, 2009].

We try to provide some materials to discuss the direction of future R&D efforts
http://www.centre-cired.fr/spip.php?article1508



Our mental map (economics)

Farm Sector
- Traditional, Backward
- Low productivity, Poverty
- Uneducated, Unskilled
- Unorganized, Informal

(Lewisian…)
development, modern growth
structural transformation…

Labour

Modern technology

Non-Farm Sector(s)
- Modern, Developed
- Capital accumulation
- Educated, Skilled, Innovating
- Organized, Formal

Development economics: *Barriers to modern agricultural technology subject to exogenous technical change jam the whole development process* [Gollin & al., 2002]

New structural economics: *Firms in developing countries can exploit the industrial and technological gap with developed countries [on the global technology frontier] by acquiring industrial and technological innovations that are consistent with their new comparative advantage* [Lin, 2011]

Agricultural economics: *Population pressure on land resources could be circumvented and labour productivity increased by several multiples (up to the levels of Western Europe in the early 1960s) by investing in agricultural research, human capital and modern agricultural inputs* [Hayami & Ruttan, 1971, 1985, 2002]

Neo-classical growth theory:
Countries with access to identical technologies should converge to a common income level …/…
Countries that are poorer and have higher marginal productivity of capital should grow more rapidly in the transition to the long-run steady state …/…
Open global economy, access to foreign capital and foreign markets further strengthen the convergence [in Rodrik, 2013]

My research questions

Where do we stand few decades after the big "agricultural modernisation push" of the 1960s, especially in Asia (Green Revolution):

1. A Lewisian growth & convergence since the 1960s?
2. if not: a matter of low yield & barriers to modern technology?
3. if not: a long historical process with "normal" widening gap in early stages of "real" growth?

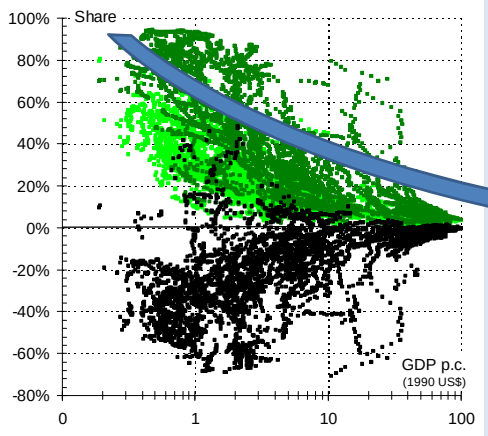
My answers in 5 bullet points

1. The Lewisian growth is bound to land availability besides technological and non-agricultural dynamics
2. Only OECD and transition countries have embarked upon the canonical Lewis Path
3. Agricultural labour force increased elsewhere (1961-2007) and farm plots shrank
4. Labour income gap of Asian farmers widened despite best growth and ranking in yield
5. Small-scale agro-ecological farms might be an alternative to mega-slum-urbanization

1 A Lewisian growth & convergence since the 1960s?

- The structural transformation [Chenery & Srinivasan, 1988]

All countries from 1970 to 2007



- share of agriculture in total value-added (*S1*)
- share of agriculture in total employment (*S2*)

The "**Lewis Path**" towards "**a World Without Agriculture**" [Timmer, 2009]

Income convergence (measurement, per worker)

- *S1 – S2* ⇨ Labour Income Gap (*LIG*) [Neg. → 0]

or: *S1 / S2* ⇨ Labour Income Ratio (*LIR*) [0 → 1]

- One or several pathways of structural transformation?

Four possible pathways…

Active population in agriculture ↗ / ↘

Income convergence (between farm & non-farm workers) ↗ / ↘

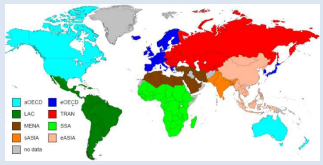
↗	Farmer-Developing	Lewis Path
↘	Lewis Trap	Farmer-Excluding

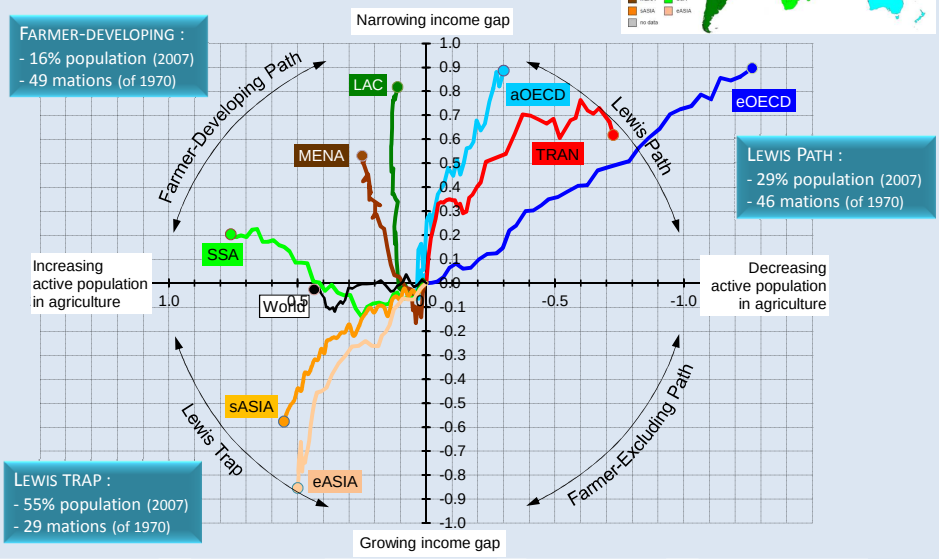
…according to
- Labour productivity growth (Θ, Θ_a)
- Agricultural sector growth (Y_a)

	$\ln(L_a) > 0$	$\ln(L_a) < 0$
$\ln(LIR) > 0$	$\ln(Y_a) > \ln(\Theta_a) > \ln(\Theta)$	$\ln(\Theta_a) > \ln(Y_a), \ln(\Theta)$
$\ln(LIR) < 0$	$\ln(\Theta_a) < \ln(Y_a), \ln(\Theta)$	$\ln(\Theta) > \ln(\Theta_a) > \ln(Y_a)$

Worldwide dynamics

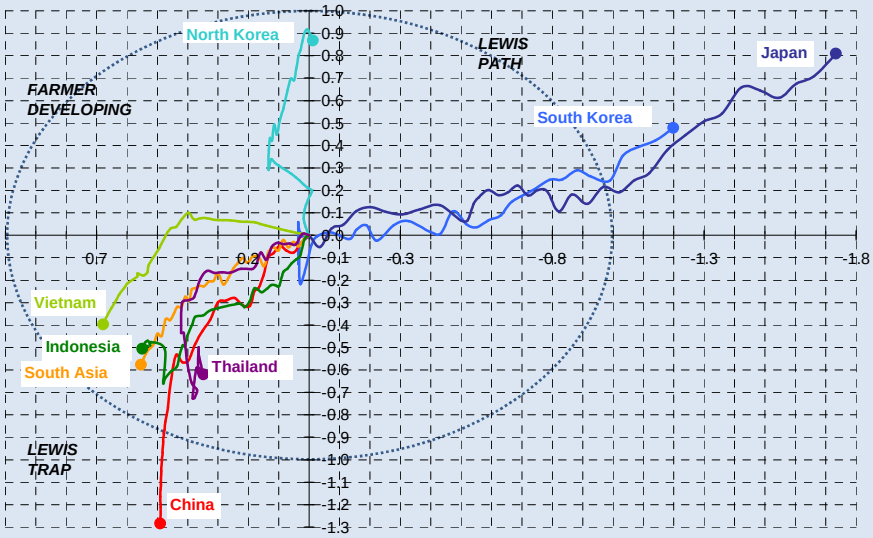
1970 ➔ ○2007
(cumulated annual growth rates)





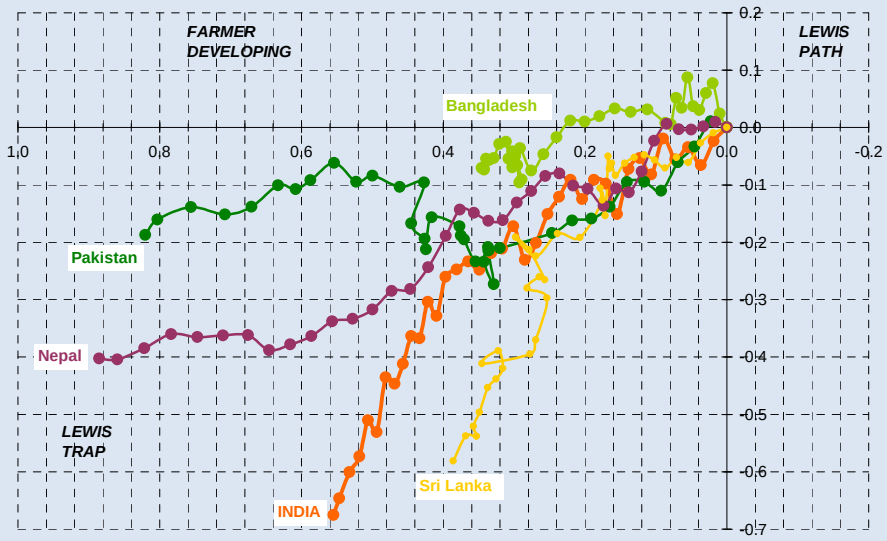
Dynamics of ASIAN countries/regions

1970 ➔ ○2007
(cumulated annual growth rates)



Dynamics of SOUTH ASIAN countries

1970 ➔ 2007
(cumulated annual growth rates)



Conclusion 1

55% of the 2007 world population (29 nations of 1970)
have embarked upon a Lewis Trap since 1970
16% upon a Farmer-Developing path (49 nations)
29% upon a Lewis Path (46 nations)

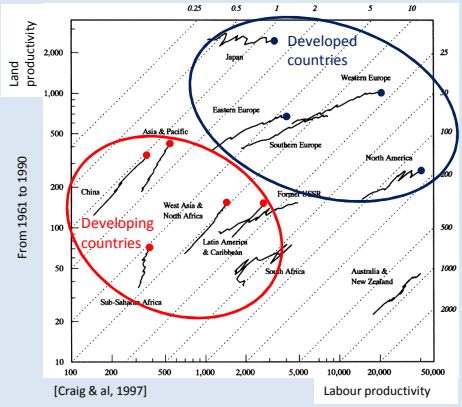
Farmer-Developing	Lewis Path
Lewis Trap	Farmer-Excluding

1970 → 2007
(average annual growth rates)

	Population (heads) Total	Workforce (workers) Total	Workforce (workers) Agriculture	Economic growth (1990-US$) Total	Economic growth (1990-US$) Agriculture	Labour productivity (1990-US$) Total	Labour productivity (1990-US$) Agriculture	Income convergence *S1 / S2*
OECD	0.69%	1.11%	–2.93%	2.81%	1.40%	1.68%	4.46%	2.75%
- Am&Oc	1.08%	1.62%	-0.89%	2.91%	2.76%	1.27%	3.69%	2.40%
- Eurasia	0.47%	0.82%	-3.42%	2.74%	0.79%	1.90%	4.36%	2.42%
TRAN	0.38%	0.38%	–1.96%	1.91%	1.07%	1.50%	3.07%	1.67%
LAC	1.89%	2.92%	0.30%	3.50%	3.03%	0.56%	2.73%	2.21%
MENA	2.44%	3.00%	0.67%	4.10%	3.07%	1.08%	2.40%	1.36%
SSA	2.75%	2.80%	2.05%	3.28%	3.09%	0.46%	1.01%	0.55%
ASIA	1.75%	2.14%	1.40%	6.76%	3.69%	4.53%	2.27%	–2.16%
- South	2.13%	2.28%	1.49%	5.17%	2.76%	2.82%	1.25%	–1.56%
- East	1.49%	2.07%	1.35%	7.61%	4.38%	5.44%	3.00%	–2.31%
World	1.61%	1.95%	1.18%	3.10%	2.25%	1.13%	1.06%	–0.07%

❷ A matter of low yield & barriers to modern technology?

■ Usual representation



[Craig & al, 1997]

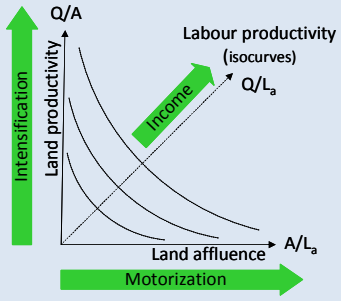
■ Our representation

① A "TALA" identity

$$Q/A \bullet A/L_a = Q/L_a$$

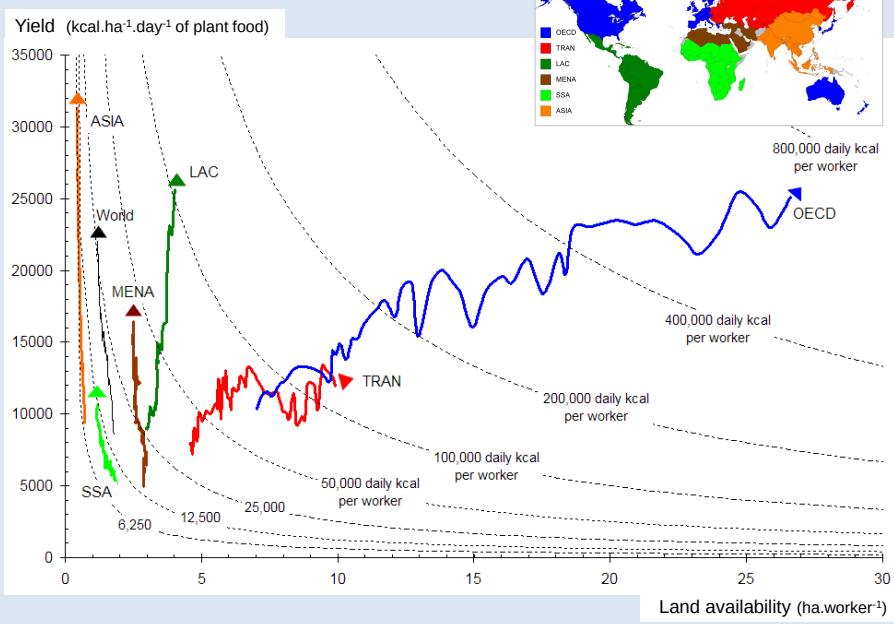
Technology (Land productivity) **A**ffluence of land (Land/Worker) **La**bour productivity

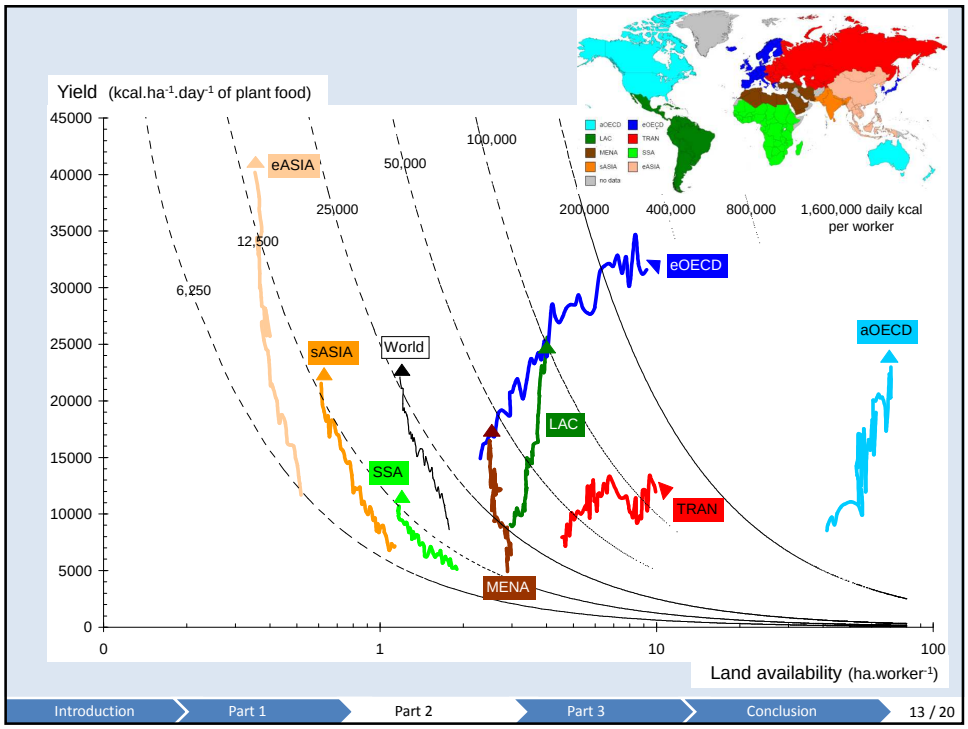
② The corresponding figure



③ With new estimates for *Q* :
- all plant food (cereals, pulses, F&V, etc.)
- produced during a year (1,2,3... crops)
- converted & aggregated into kcal

■ A silent bifurcation (1961-2007)




Yield (kcal.ha-1.day-1 of plant food)
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
0
1
10
100
Land availability (ha.worker-1)
eASIA
12,500
6,250
25,000
50,000
100,000
200,000
400,000
800,000
1,600,000 daily kcal per worker
sASIA
World
SSA
MENA
LAC
eOECD
TRAN
aOECD
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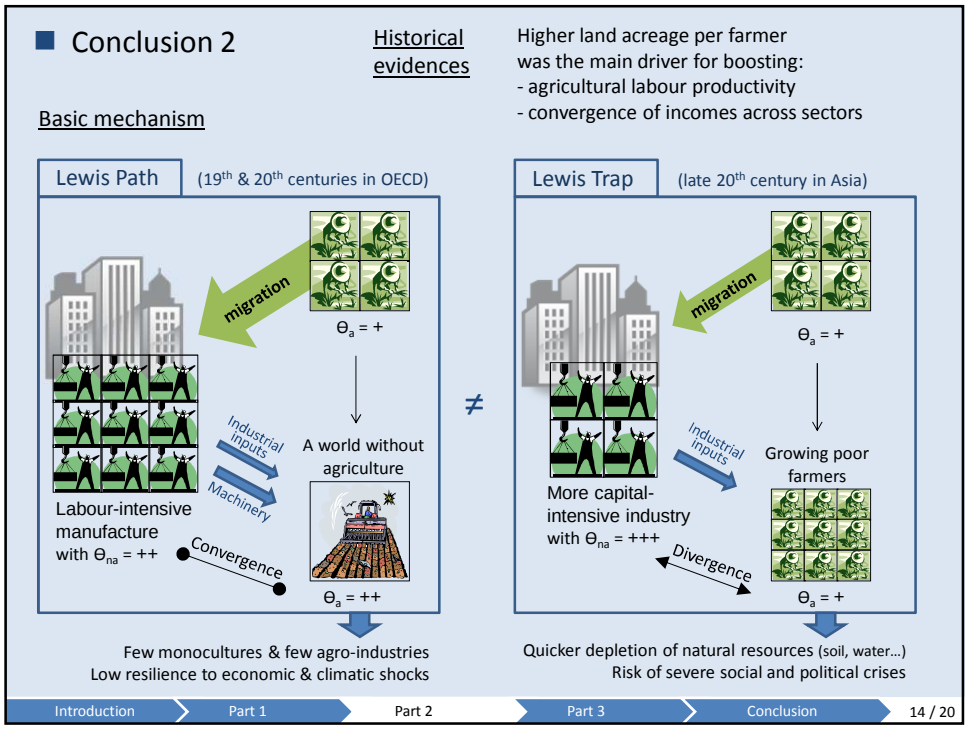
Conclusion 2
Historical evidences
Higher land acreage per farmer was the main driver for boosting:
- agricultural labour productivity
- convergence of incomes across sectors
Basic mechanism
Lewis Path
(19th & 20th centuries in OECD)
migration
Θa = +
Industrial inputs
Machinery
A world without agriculture
Labour-intensive manufacture with Θna = ++
Convergence
Θa = ++
≠
Lewis Trap
(late 20th century in Asia)
migration
Θa = +
Industrial inputs
Growing poor farmers
More capital-intensive industry with Θna = +++
Divergence
Θa = +
Few monocultures & few agro-industries
Low resilience to economic & climatic shocks
Quicker depletion of natural resources (soil, water…)
Risk of severe social and political crises
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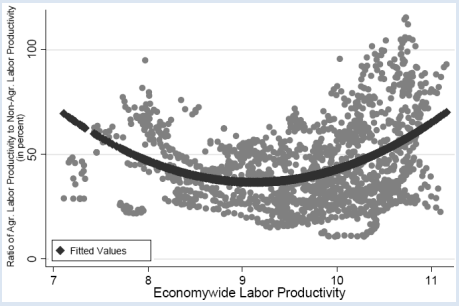
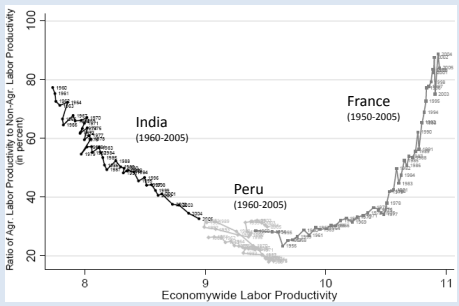
❸ A long historical process with widening gap in early stages?

- Nothing wrong, let us wait?

Structural transformation is a long historical process characterized in the early stages by a widening gap between farm and non-farm labour productivity

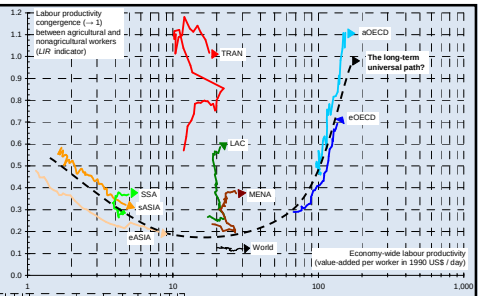




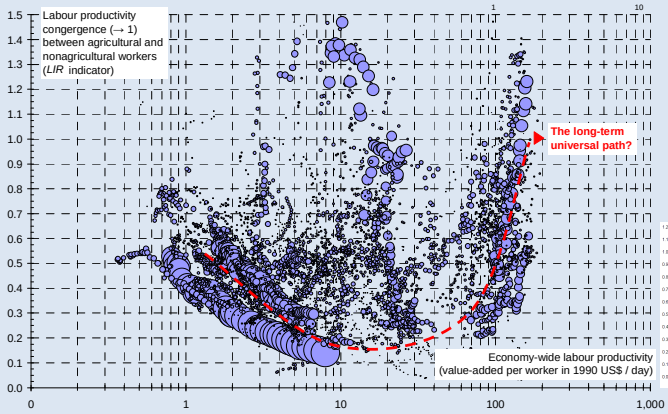
[McMillan & Rodrik, 2012, pp. 9-10]

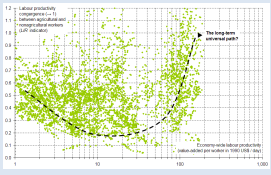
A long-term universal OECD path ???

All countries into eight regions (1970-2007)



All countries weighted by their active population (1970-2007)





A heuristic numerical experiment on India

	Past 1980 => 2007	Shukla & Dhar's scenario 2007 => 2050	"Lewis Path" scenario 2007 => 2050
Population	+1.94 % => 1165 M	**+0.76 % => 1615 M**	**+0.76 % => 1615 M**
Growth (GDP)	+6.1 %	**+7.3 %**	**+7.3 %**
- agriculture	+3.0%	**+2.6 %**	**+2.6 %**
- non-agriculture	+7.2%	**+7.7 %**	**+7.7 %**
Labour productivity	+3.9 %	**+6.2 %**	**+6.2 %**
- agriculture	+1.6 %	**+3.0 %**	**+9.3 %**
- non-agriculture	+3.7%	**+5.4 %**	**+4.6 %**
Workforce	+2.2 % ⇨ 463 M	**+1.1 % ⇨ 735 M**	**+1.1 % ⇨ 735 M**
- agriculture	+1.4 % ⇨ 259 M (56%)	–0.4 % ⇨ 217 M (30%)	–6.2 % ⇨ 17 M (2%)
- non-agriculture	+3.4 % ⇨ 204 M (32%)	+2.2 % ⇨ 518 M (70%)	+3.0 % ⇨ 718 M (98%)
Income gap Agri/Non-Agri	1 / 6	1 / 17	1 / 1

Workforce in agriculture (change over the period)	+ 82 M workers (+146 M people)	– 41 M workers (– 156 M people)	– 242 M workers (– 547 M people)
Land availability (end year)	0.66 ha/worker	0.78 ha/worker	Max 10 ha/worker

Conclusion 3

A country like India can hardly follow the canonical Lewis Path

(1) Industry is less able to absorb labour than in the past
- Labour productivity ↗ (economy of scale, motorization/automation)
- Sector growth slows down (increasing cost of oil and other non-renewable raw materials, strengthening of environment-friendly regulations, market saturation in industrialized countries, slower increase of wages in developed economies not compensated by an increase elsewhere…)

(2) It would require a mega-urbanization ever faced in history
- No more "open spaces" for exporting labour surpluses
  (60 million Europeans emigrate to the "New Worlds" between 1850 and 1930)
- Lewis Path scenario for India (2050): 80% of the population (1.3 billion people out of 1.6) lives in cities whose density reaches 55,000 inhabitants per km^2
  (35,000 in Dhaka and 27,100 in Mumbai in 2010, the two current densest cities in the world)

(3) Farm labour productivity cannot be boosted as in OECD countries
Limited prospects of:
- Large-scale moto-mechanization: max 10 ha/farmer in 2050 (150 in CA, 63 in US, 30 in FR... in 2007)
- Higher yield with modern industrial inputs (fertilizer, pesticide, oil…): ever-increasing costs + decreasing marginal productivity + negative externalities
  (on natural resource, climate, animal and human health…)
- International market: trade barriers + market powers
  (from large-scale and well-organized agro-industries that emerged during the past century)

Conclusion

Towards a paradigm shift ?

- The equation at stake
- A 2050 vision

Science & farmers managing
a mosaic of agro-ecosystems
boosting local synergies
amongst many plant and animal species
above & below the ground surface.

Increasing farmers' income & production

…without sending most of them to shantytowns

$$\theta_a = (pQ - Y_{na}^a) / L_a$$

Prices

Costs of non-agricultural inputs

The "agro-ecological perspective" [Altieri, 1999] ?
or "matrix" [Perfecto & Vandermeer, 2010] ?
The "Ecological intensification" (www.cirad.fr) ?
The "Reverse innovation" [Vijay Govindarajan] ?
The "Nano eco-friendly capitalism" ?
The "Agricultural eco-friendly Jugaad" ?
…/…

R&D agendas ?

❶ Higher biodiversity & biological synergies
↗ production ***Q*** (total useful biomass)
↗ resilience to economic & climatic shocks

❷ Saving of inputs ***Y***
↘ production costs (higher incomes)
↘ environmental costs

❸ Higher prices ***p***
↗ quality (tasty/nutritious food)
↗ co-products (wood, fuel, fibre, drugs…tourism)
↗ ecosystem services (local & global)

❹ Higher labour intensity L_a:
- for knowledge-intensive & context-specific work
- small family farms usually more productive & profitable per hectare [Sen 1964; Wiggins et al. 2010]

- Two pending questions…

❶ How our societies and their institutions get organized to promote and remunerate properly collective and public goods provided by agriculture?

❷ How this new agriculture and rural organization can emerge and coexist with large-size agro-industries that now feed a growing portion of humankind?

Thanks for your attention

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• …/…